dena
Deutsche Energie-Agentur

Sino-German Partnership: Workshop on Improving Data Centre Energy Efficiency
中德数据中心能效提升专家研讨会

Status of Data Centres Energy Efficiency in Germany
德国数据中心能效现状

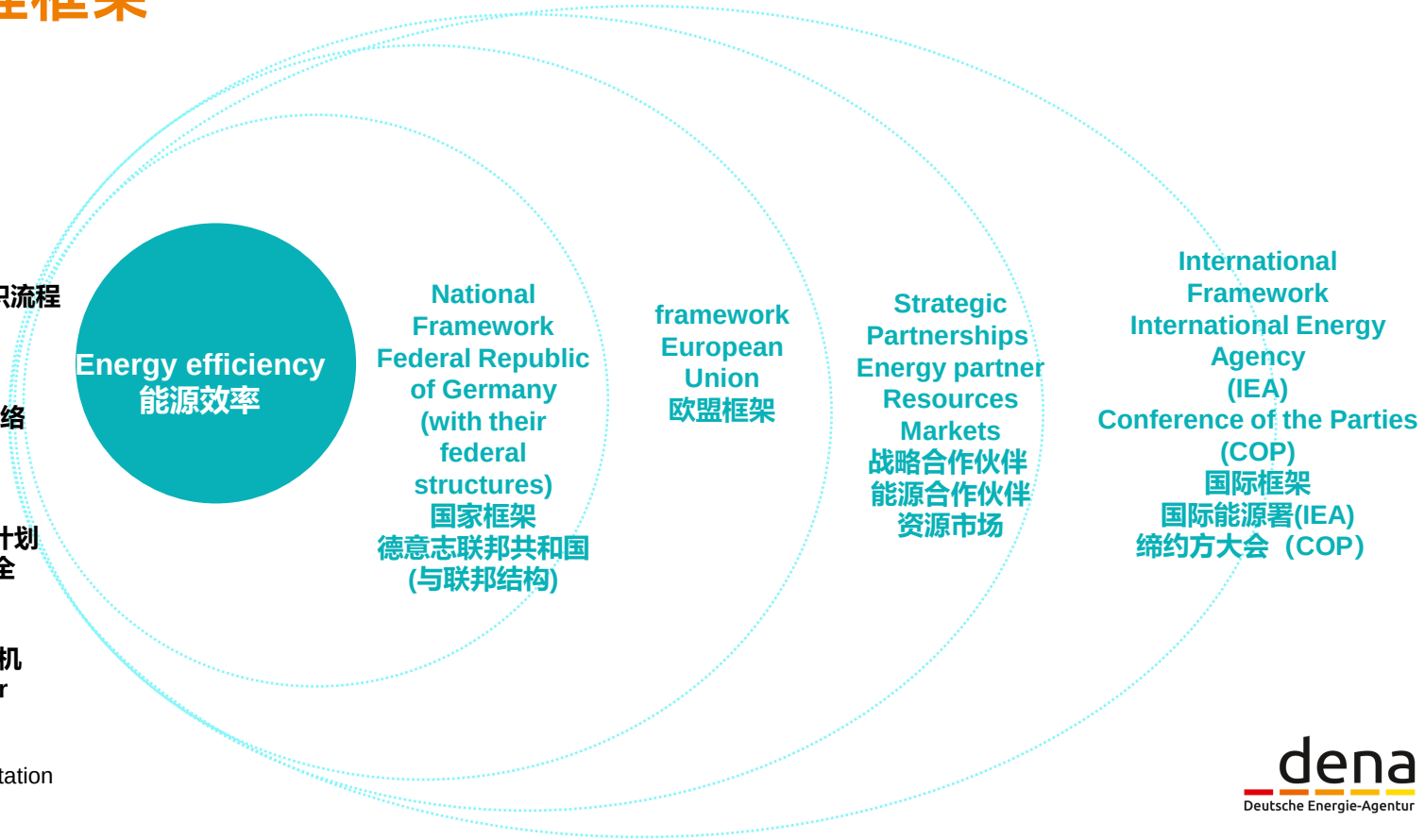
Getty Images/piranka

The multi-level governance framework
多层次治理框架

Implementation 实施
Private Households 个人
Corporates 企业
Public agents 公共机构

Action cluster 行动集群
Information 信息
Organisational processes 组织流程
Technologies 技术
Services 服务
Sufficiency 充分性
Efficiency networks 效率网络

Impact factors 影响因素
Regulation 法规
Support programmes 支持计划
Planning security 规划安全
Price signals 价格信号
Digitisation 数字化
(Energy) crises （能源）危机
Shortage of skilled labour
缺乏熟练劳动力



dena
Deutsche Energie-Agentur

EU Energy Efficiency Directive (EED)
欧盟《能效指令》(EED)

- **EU directive:** Legal act in which climate target to be achieved by the EU countries is defined. Member states must then enact their own legislation to realise this goal.
- **欧盟指令：**确定欧盟国家要实现的气候目标的法律文件。成员国必须制定相应法规来实现这一目标。
- **Timeline of the EU Energy Efficiency Directive (EED):**
  - **November 2012:** adopted for the first time for EU 2020 targets
  - **December 2018:** amended for EU 2030 targets
  - **July 2021:** "Fit-for-55 package" to adapt existing EU climate and energy regulations, including plans for a new EED amendment
  - **October 2023:** amended for ambitious EU 2030 targets
- **欧盟《能效指令》（EED）时间线：**
  - **2012 年 11 月：**首次确定欧盟 2020 年目标
  - **2018 年 12 月：**对欧盟 2030 年目标进行修订
  - **2021 年 7 月：** 提出“Fit-for-55 ”一揽子计划（ “Fit-for-55 package”）以适应欧盟现有的气候和能源法规， 其中包括修订《欧盟能效指令》的计划
  - **2023 年 10 月：**根据欧盟雄心勃勃的 2030 年目标进行修订

dena
Deutsche Energie-Agentur

Energy efficiency policy and climate targets
能源效率政策和气候目标

- **Climate targets → Targets for achieving greenhouse gas neutrality**
  - EU: Greenhouse gas neutrality by 2050, by 2030 CO2 reduction 55 % compared to 1990 (EU climate law), reduction in primary energy consumption 39 % (EED*).
  - National: Greenhouse gas neutrality by 2045, 65% CO2 reduction by 2030 and 88% by 2040 compared to 1990 (Climate Protection Act 2019, amended 2021)
- **Realisation**
  - at EU level: "Fit for 55" package: proposal to amend the EED* (June 2022)
  - at national level: Climate Protection Emergency Programme (2022), Energy EfficiencyAct (2023), Building Energy Act (2023)

- **气候目标 → 实现温室气体中和的目标**
  - 欧盟层面：到 2050 年实现温室气体中和，到 2030 年，二氧化碳排放量比 1990 年减少 55%（《欧盟气候法》），一次能源消耗量减少 39%（欧盟《能效指令》）。
  - 国家层面：到 2045 年实现温室气体中和， 与 1990 年相比， 到 2030 年减少 65% 的二氧化碳，到 2040 年减少 88%（2019 年德国《气候保护法》，2021 年修订）
- **实现**
  - 欧盟层面：“Fit for 55 ”一揽子计划：提出修订欧盟《能效指令》*（2022 年 6 月）
  - 国家层面：“气候保护紧急计划”（2022 年）、《能源效率法》（2023 年）、《建筑能源法》（2023 年）

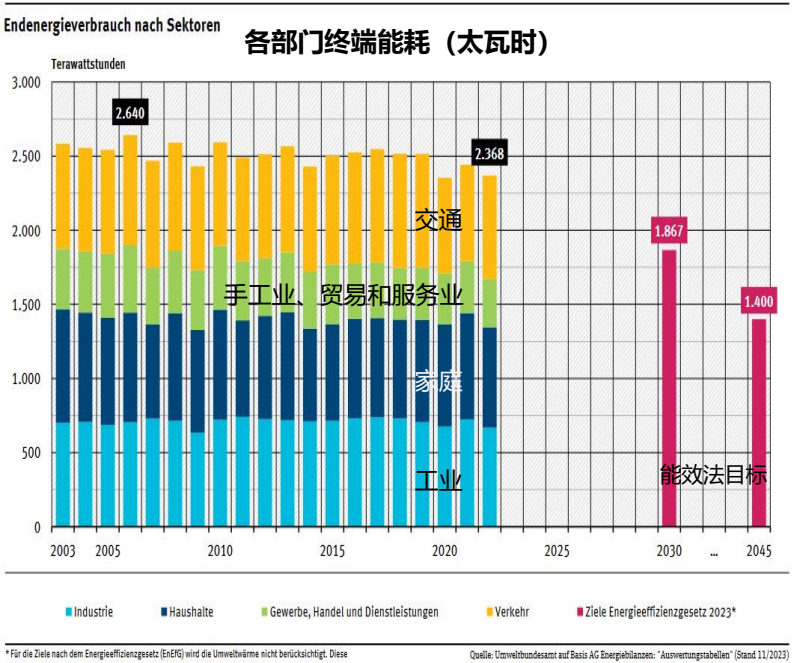
*EED: Energy Efficiency Directive 《能效指令》

Objectives and effects of the EnEffG
德国《能源效率法》的目标和影响

- **The EnEffG has been in force since 18 November 2023.**
- **Implements key requirements of the Energy Efficiency Directive (EED), which came into force on 10 October 2023**
- **brings together European requirements and national crisis response and long-term goals**
- **Makes an important contribution to achieving Germany's climate targets.**
- **Goal: Use scarce and expensive energy resources as sparingly and efficiently as possible. Ensure achievement of the efficiency targets for 2030 (EEV -26.5%, PEV -39.3% compared to 2008); targets for 2045 (EEV -45% compared to 2008).**
- **Creates a cross-sectoral framework for increasing energy efficiency for the first time.**
- **Contains concrete measures for reducing energy consumption in Germany.**
- **The ICT sector is mentioned in this context as an area of growing importance and certain requirements for data centres are provided for in the EnEffG.**

- 德国《能源效率法》自 2023 年 11 月 18 日起生效。
- 执行欧盟《能效指令》(EED)（于2023 年 10 月 10 日生效）的主要要求
- 将欧盟要求、各国的危机应对措施和长期目标结合
- 为实现德国的气候目标做出了重要贡献。
- 目标：尽可能节约、高效地使用稀缺、昂贵的能源资源。确保实现 2030 年的能效目标（与 2008 年相比，终端能耗减少 26.5%，一次能源消费减少 39.3%）；以及 2045 年的目标（与 2008 年相比，终端能耗减少45%）。
- 首次为提高能效创建了一个跨部门框架。
- 为德国减少能源消耗提出具体措施。
- 在此背景下，信息与通信技术（ICT）被视为一个日益重要的领域，德国《能源效率法》对数据中心提出了特定要求。

Reduction of final energy consumption by 1000 TWh.
终端能耗减少 1000 太瓦时



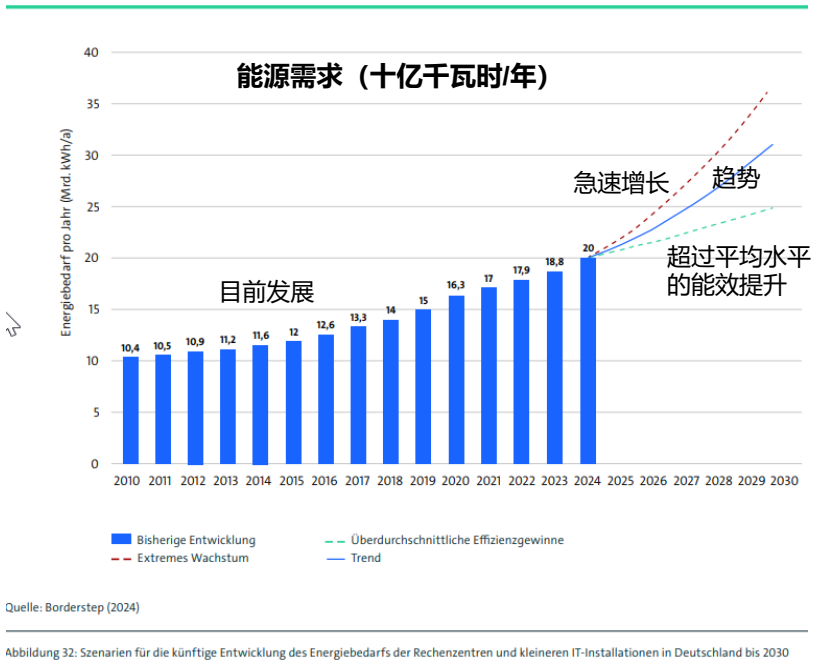
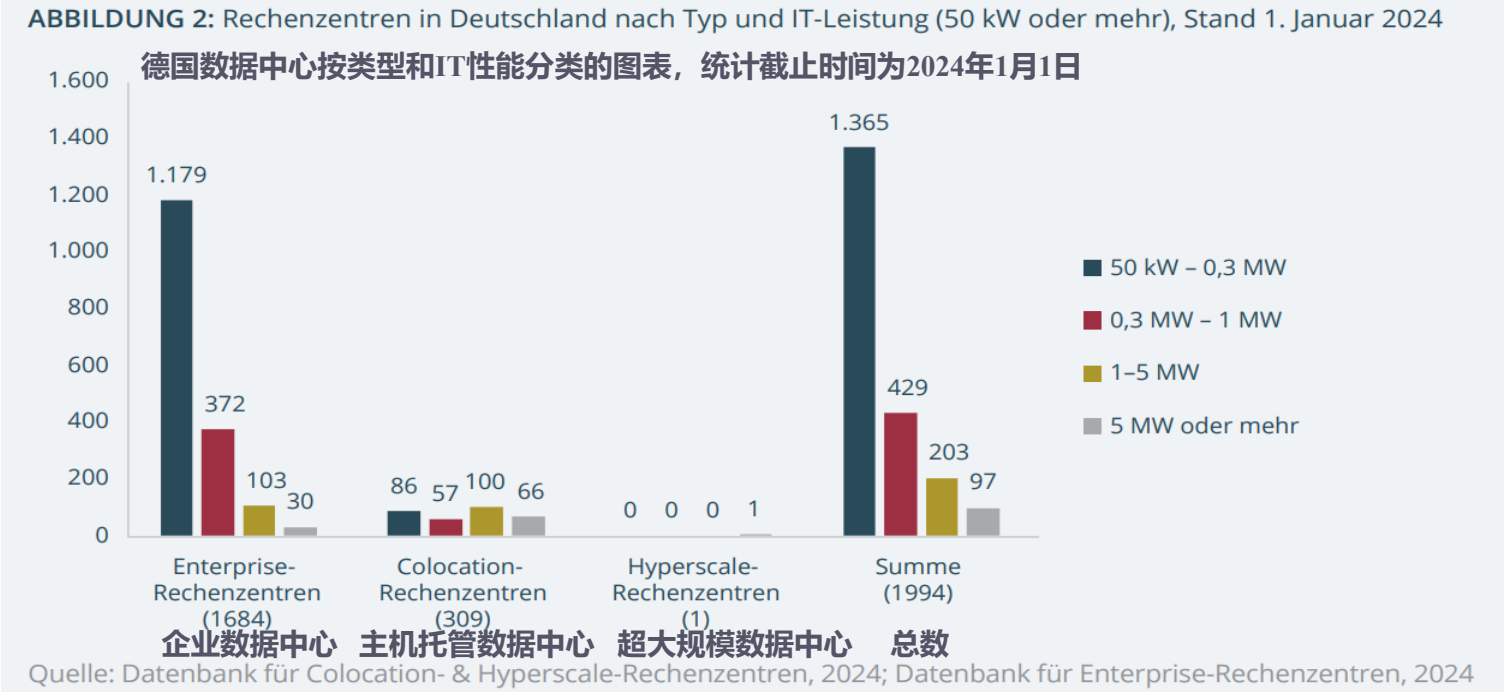


Abbildung 32: Szenarien für die künftige Entwicklung des Energiebedarfs der Rechenzentren und kleineren IT-Installationen in Deutschland bis 2030

Source: Federal Environment Agency based on AG Energiebilanzen: "Evaluation tables" (as of 11/2023)
资料来源：德国联邦环境署，基于 AG Energiebilanzen的评估表（截至 2023 年 11 月）

dena
Deutsche Energie-Agentur

Data centres capacities in Germany 德国数据中心的容量



- Source, GDA, 2024
- 资料来源：GDA，2024 年

dena
Deutsche Energie-Agentur

PUE

- **Commissioning before July 2026 must achieve PUE of <= 1.5 from 1 July 2027 and <= 1.3 from 1 July 2030.**
- **Commissioning from July 2026 must achieve PUE of <= 1.2**
- **Mandatory waste heat utilisation for new data centres as a minimum:**
- **10% - from July 2026,**
- **15% - from July 2027**
- **20% - from July 2028**
- **In order to achieve the required PUE limit value, the selection of a suitable cooling system must always be carefully considered**

电力使用效率(PUE)

- 2026 年 7 月前投入使用的设备必须从 2027 年 7 月 1 日起实现 PUE <= 1.5，从 2030 年 7 月 1 日起实现 PUE <= 1.3。
- 自 2026 年 7 月起投入使用的设备必须实现 PUE <= 1.2
- 对数据中心的余热利用进行强制规定：
- 自 2026 年 7 月起至少10%
- 自 2027 年 7 月起至少15%
- 自 2028 年 7 月起至少20%
- 为了达到所要求的电力使用效率极限值，必须始终考虑选择合适的冷却系统

Regulation on waste heat use

余热利用法规

- **Before the EnEfG came into force, site selection was largely based on the criteria set out in DIN EN 50600 (availability of electricity and fibre optic cables, physical safety criteria such as flooding, airport access routes, proximity to motorways and railway lines, etc.) whereas now it is also mandatory to look at potential heat consumers.**
- **Demand from the housing industry and heating network operators is high as a result of the Building Energy Act and the Heat Planning Act. This is because waste heat from data centres is considered unavoidable waste heat and is therefore an option for achieving the targets for sustainable heat supply described therein. Heating network operators must gradually feed their heating networks with more and more heat sources from renewable energies or unavoidable waste heat.**

- 在 德国《能源效率法》 生效之前，数据中心选址主要基于 DIN EN 50600 中规定的标准（电力和光纤电缆的可用性、物理安全标准，如洪水、机场通道、靠近高速公路和铁路线等），而现在还必须考虑潜在的热消费者。
- 《建筑能源法》和《供热规划法》实施后，住宅产业和供热网络运营商的热需求很高。数据中心余热作为不可避免的余热，是实现可持续供热转型目标的热源之一。热网运营商必须逐步为其供热网络提供越来越多的可再生能源或不可避免的余热热源。

dena
Deutsche Energie-Agentur

Regulation on electricity from RES
可再生能源发电法规

- **According to Section 11, data centre operators must cover 50 percent of the electricity consumption in their data centres with electricity from renewable energy sources from 1 January 2024 and 100 percent balance sheet-based from 1 January 2027. The addition of "balanced" explicitly allows the requirement to be met by means of certificates or power purchase agreements (PPAs).**
- **根据第 11 条规定，数据中心运营商必须从 2024 年 1 月 1 日起，使用可再生能源电力覆盖其数据中心50%的电力消耗，并从2027年1月1日起实现100%可再生能源电力覆盖，可通过绿证或电力购买协议（PPAs）的方式满足100%可再生能源电力覆盖的要求。**

Regulation on introduction of EMS
关于引入环境管理体系的法规

- **The establishment of energy or environmental management systems is regulated by § 8 for companies in general and by § 12 for data centres in particular. Normative reference to energy management systems (EnMS) can be found in DIN EN ISO 50001. Environmental management systems (EMS) are explicitly those according to EMAS.**
- **第 8 条（一般适用于公司）和第 12 条（特别适用于数据中心）规定了能源或环境管理体系的建立。能源管理体系（EnMS）的规范性参考文件可参考 DIN EN ISO 50001 。环境管理体系 (EMS) 是指符合欧盟生态管理审核体系 (EMAS) 标准的管理系统。**

Transmission of data to registers for energy efficiency of data centres

传送数据进行注册

Operators of data centres with a non-redundant rated electrical load of at least 300 kW are obliged to report data to the DCReg:

- **Total electricity consumption including own generation, total electricity consumption and electricity fed back into the supply grid,**
- **Share of renewable energies in total electricity consumption**
- **Quantity and average temperature of measurable or estimable waste heat released to air, water or soil,**
- **Amount of waste heat supplied by the data centre to heat consumers in kilowatt hours per year and its average temperature in degrees Celsius,**
- **Amount of data stored and processed in the data centre,**
- **Energy efficiency of the entire data centre,**
- **Share of reused energy**
- **Efficiency of the cooling system**
- **Efficiency indicator for water utilisation**

拥有非冗余额定电负载至少 300 kW 的数据中心运营商有义务向 DCReg报告以下数据：

- **总用电量，包括自发电、总耗电量和馈入电网的电量**
- **可再生能源在总用电量中的占比**
- **可测量或可估算的余热（释放到空气、水或土壤中的余热）量及其平均温度**
- **数据中心向供热用户每年供应的余热量（以千瓦时为单位）及其平均温度（以摄氏度为单位）**
- **数据中心存储和处理的数据量**
- **整个数据中心的能源效率**
- **再利用能源的比例**
- **冷却系统的效率**
- **用水效率指标**

dena
Deutsche Energie-Agentur

Current results and Improvements in Energy efficiency
目前的成果和能效的提高

- The PUE improved to 1.46 in 2024 (Borderstep, 2024)
- Trend towards modern IT and building infrastructure
- In addition to energy efficiency the resource efficiency is also becoming increasingly important (very economical use of water)
- Research data centres are particularly efficient with an average PUE of 1.14, followed by hosting and cloud data centres at 1.37, colocation data centres at 1.38 and on-premise data centres at 1.46 (Borderstep, 2024)
- Waste heat utilisation projects (e.g. Cyrus One CO_2 - emission factor of 0)
- CO2 emissions in data centres stabilised

- PUE在 2024 年提高到 1.46（Borderstep 研究所，2024 年）
- 现代信息技术和建筑基础设施的发展趋势
- 除了能源效率，资源效率也变得越来越重要（如：高效用水）
- 研究型数据中心的平均PUE最高，为 1.14，其次是托管和云数据中心为1.37，主机托管数据中心为1.38，内部数据中心为1.46（Borderstep研究所，2024 年）。
- 余热利用项目（如：Cyrus One CO2 - 排放系数为 0）
- 数据中心的二氧化碳排放量保持稳定

Pathways and perspectives for future developments
未来发展的途径和前景

- **Development of the strategic vision**
- **Creation of the supportive infrastructure for implementation of norms of the law**
- **Dialogue formats and stakeholders connection**
- **Regulatory innovation**

- **制定战略愿景**
- **为执行法律规范建立支持性基础设施**
- **对话形式与利益相关方的联系**
- **监管创新**

Thank you very much
非常感谢

Dr. Zhanat Murzakulova

zhanat.murzakulova@dena.de
www.dena.de